Personalized Implantable Scaffolds for Wound Treatment and Management

Prabhakar, Ashwin (School: Bob Jones High School)

Wound treatment and management are major healthcare problems affecting more than 7 million people in the United States and costing more than $50 billion annually. Although skin grafting and bioprinting have advanced treatment options for deep cavity wounds, these are expensive, time consuming, and require trained personnel which limits their use. The goal of this project was to develop a rapid, customized, low-cost, personalized implantable scaffold for treatment and management of deep cavity wounds. A turntable was designed in CAD, 3D printed, and integrated with a laser alignment based imaging system for capturing 360 degrees of artificial wounds. Images were post-processed to yield 3D models which were used to 3D print wound specific molds. Alginate, a natural biomaterial, was adapted to create personalized scaffolds from the molds using a custom automated extrusion system resulting in scaffolds that were a perfect fit to the wounds. Integration of an electrically active pectin film with the scaffold enabled temperature monitoring of the wounds and a fluorescence based assay demonstrated drug release over a period of 96 hours. Finally, the wound molds were shipped to external laboratories for testing with additional scaffold materials and cells. Results showed successful scaffold formation with greater than 95% cell viability. This system costing less than $500 can generate implantable scaffolds in as little as 3 hours highlighting the low-cost and rapid development process. This method for personalized implantable scaffolds has great potential for use in any setting while providing significant reduction in wound treatment costs and time.

Awards Won:

International Council on Systems Engineering - INCOSE: Certificate of Honorable Mention